(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: 10154284 A
(43) Date of publication of application: 09.06.1998

(51) Int. Cl G08B 17/107
H04N 7/18

(21) Application number: 08311718
(22) Date of filing: 22.11.1996

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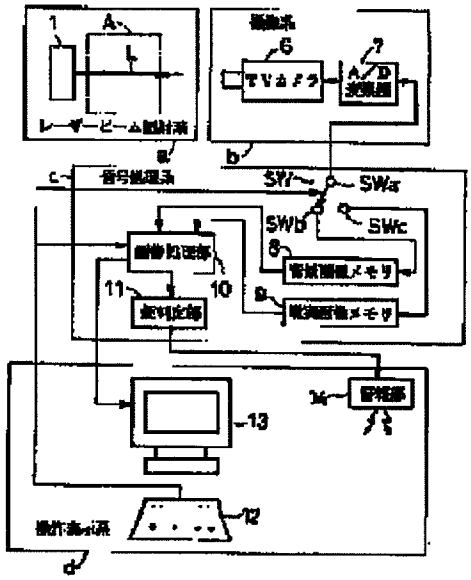
(54) SMOKE SENSING SYSTEM

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a smoke sensing system which eliminates erroneous sensing of smoke and grasps the generating situation and the generating place of smoke in addition.

SOLUTION: This smoke sensing system is provided with a laser beam radiating device 1 radiating a laser beam L toward a smoke sensing area A being an object of sensing the generation of smoke, a TV camera 6 photographing the area A and a display monitor 13 projecting a picture obtained based on photographing with the camera 6. The variation of the laser beam L accompanying the generation of smoke is caught by the camera 6 and made a picture, to sense smoke.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]While preventing perceiving this invention noting that smoke occurs, although incorrect perception (mistake perception), i.e., smoke, has not occurred in particular about the smoke sensing system which detects generating of the smoke in the building which serves as uninhabited in an uninhabited substation or the night, for example, It is related with the art for also enabling the generation state of smoke, and grasp of a generation place.
[0002]
[Description of the Prior Art]Conventionally, there are an ionization type and a photoelectric method as a method which detects smoke. The former is a smoke perception method using the phenomenon of changing with the particles of the smoke with which the value of the ion current of the ion interior of a room which used the radiation source flowed into the ion interior of a room. The latter is constituted so that the light flux (non-laser) of the light source lamp irradiated by one way into the camera which only smoke puts in may be detected with a photo detector. The latter method is a smoke perception method using the phenomenon in which the resistance of a photo detector changes in connection with light flux being scattered about by the particles of the smoke which flowed into the camera. The smoke perception by these methods demonstrates power to the early detection of a fire, etc.
[0003]
[Problem(s) to be Solved by the Invention]However, the above-mentioned conventional smoke perception method can detect only the existence of smoke. There is a problem that the generation state of smoke, for example, whether smoke has come out from the ceiling or it has come out from the floor, and the thing for which the generation place of smoke is grasped, is not made at all. If the generation state of smoke and grasp of a generation place are insufficient, it is doubtful to perform suitable extinction work promptly for example. Since the change of ion current and the change of the resistance of a photo detector by the inflow of smoke are slight to it, the malfunction (mistake perception) perceived noting that smoke occurs, although smoke has not occurred takes place to it easily, and the problem that it is unreliable also has them in it. If the reliability of smoke perception is scarce, even when smoke will have been perceived truly, there are not few dangers of it being overlooked as mere mistake perception and inviting the serious situations, such as a disastrous fire.
[0004]This invention makes it SUBJECT to provide a smoke sensing system which also enables the generation state of smoke, and grasp of a generation place while canceling mistake perception of smoke in view of the above-mentioned situation.
[0005]
[Means for Solving the Problem]In order to solve said SUBJECT, a smoke sensing system concerning an invention of Claim 1 is provided with the following.
A laser beam irradiation means which irradiates with a laser beam smoke sensing area as an object domain which detects generating of smoke.
An imaging means which photos smoke sensing area.
A monitor for a display which projects a picture photoed by an imaging means.

[0006]In the smoke sensing system according to claim 1 an invention of Claim 2, A background image memory measure which memorizes a background image of smoke sensing area beforehand photoed by imaging means, while having a current image memory measure which memorizes a picture of smoke sensing area which is [every moment] alike by an imaging means, and is photoed as a current image, and an image processing means which performs data processing which deducts a background image from a current image, It is constituted so that a picture acquired by data processing by an image processing means may project on a screen of a monitor for a display.
[0007]An invention of Claim 3 is provided with a smoke judging means which detects generating of smoke based on a picture of smoke sensing area obtained by an imaging means, and outputs a smoke sensing signal, and an alarm generating means which emits an alarm in response to a smoke sensing signal in the smoke sensing system according to claim 1 or 2.

[0008]As for an invention of Claim 4, in a smoke sensing system given in either from Claim 1 to 3, a laser beam irradiation means is constituted so that smoke sensing area may be irradiated with two or more laser beams located in a line almost in parallel.
[0009]In a smoke sensing system given in either from Claim 1 to 4, an invention of Claim 5 is constituted so that a laser-beam-irradiation means may scan a laser beam and smoke sensing area may be irradiated.
[0010]While a remote transmission means to which an invention of Claim 6 performs remote transmission of a picture in the latter part of an imaging means in a smoke sensing system given in either from Claim 1 to 5 is allocated, a monitor for a display is installed in a remote transmission destination of a picture.
[0011]A laser beam in which an invention of Claim 7 has the wavelength of an invisible optical area as a laser beam in a smoke sensing system given in either from Claim 1 to 6 is used.
[0012]
[Function]Next, a smoke perception operation of the smoke sensing system concerning this invention is explained. When smoke perception is performed by the smoke sensing system of Claim 1, a laser beam is irradiated by a laser beam irradiation means by the smoke sensing area as an object domain which detects smoke generating. The smoke sensing area where the laser beam is irradiated is photoed by the imaging means. The picture which might be based on photography by an imaging means is projected on the screen of the monitor for a display. When smoke occurs in smoke sensing area, in a laser beam, a remarkable change appears in dispersion by the particles of smoke. A remarkable change of this laser beam is projected on the screen of the monitor for a display in the form according to the occurrence position and generation state of smoke in smoke sensing area.
[0013]In the smoke sensing system of Claim 2, data processing which deducts the background image of the smoke sensing area beforehand memorized by the background image memory measure from the current image memorized by the current image memory measure is performed by an image processing means. The picture acquired by data processing by an image processing means is projected on the screen of the monitor for a display. Therefore, only the image which shows a changed part from a background image will be extracted and displayed on the screen of the monitor for a display. When there is generating of smoke in smoke sensing area, only the image which shows only a part for the image change accompanying change of the laser beam by generating of smoke is taken out, and it projects on the screen of the monitor for a display.
[0014]While a smoke judging means detects generating of smoke automatically based on the picture of the smoke sensing area obtained by an imaging means and outputs a smoke sensing signal in the smoke sensing system of Claim 3, Since an alarm generating means emits an alarm automatically in response to a smoke sensing signal, generating of smoke will be automatically told by the alarm of an alarm generating means.
[0015]In the smoke sensing system of Claim 4, since it is the composition with which two or more laser beams which a laser beam irradiation means outputs, and which were located in a line almost in parallel irradiate smoke sensing area, respectively, smoke sensing area is set up widely. As a result, the generation state of smoke and grasp of a generation place become easy.
[0016]In the smoke sensing system of Claim 5, since a laser beam irradiation means scans a laser beam and irradiates smoke sensing area, smoke perception can be carried out about wide range area by a small number of laser beams.
[0017]In the smoke sensing system of Claim 6, it is transmitted to the place where the picture separated from the picture of smoke sensing area by the remote transmission means currently allocated in the latter part of an imaging means (remote transmission). A picture projects on the screen of the monitor for a display by which this picture is installed in the remote transmission destination, and perception of smoke generating is performed in the place distant from smoke sensing area.
[0018]In the smoke sensing system of Claim 7, since the laser beam for smoke perception has the wavelength of an invisible optical area, when smoke has not occurred, the laser beam which runs smoke sensing area is not visible to people's eyes.
[0019]
[Embodiment of the Invention]Then, one working example of this invention is described, referring to Drawings. The block diagram showing the entire configuration of the smoke sensing system which requires drawing 1 for working example, and drawing 2 are perspective views which see through the interior of a room in which the laser-beam-irradiation system and

imaging system in the working example system were installed, and are expressed. Drawing 3 is a schematic diagram showing the internal configuration of the laser-beam-irradiation unit used for the system of working example.

[0020]As shown in drawing 1, the smoke sensing system of working example roughly, The laser beam illuminating system a for irradiating smoke-sensing-area A with the laser beam L. It comprises four portions of the operation display system d for performing operation required for the signal-processing system c for performing signal processing to the picture acquired by the imaging system b and the imaging system b for photoing smoke-sensing-area A, and the display of a picture and operation of a system. Hereafter, the composition of each part is explained in detail.

[0021]First, the laser-beam-irradiation system a is explained. The laser-beam-irradiation system a comprises the laser-beam-irradiation device 1 which has the three laser-beam-irradiation units 2, as shown in drawing 2. After the laser beam L of a parallel ray is emitted from each laser-beam-irradiation unit 2, smoke-sensing-area A respectively set up over the indoor internal surface W is turned horizontally, and it dies spontaneously at equal intervals.

[0022]The laser-beam-irradiation unit 2 has the lens 3 for floodlighting in a front face, as shown in the front view of drawing 3 (a), and the top view of drawing 3 (b). The semiconductor laser 4 is arranged at the position P1 in which only suitable distance fell back further from the focus f1 by the side of the back on the optic axis 3a of this lens 3 for floodlighting. It seems that this semiconductor laser 4 is arranged at the position P2 which only suitable distance followed before conversely from the focus f1. The semiconductor laser 4 outputs the parallel laser beam (a metaphor is a red laser beam) which has the wavelength of a light range.

[0023]The semiconductor laser 4 is a rectangle with a longwise vertical section. This is expanded with the lens 3 for floodlighting, and is floodlighted by smoke-sensing-area A as the parallel laser beam L. In the laser-beam-irradiation unit 2 of drawing 3, although the lens 3 for floodlighting was the lens constitution of one sheet, the lens 3 for floodlighting may be the lens constitution of two or more sheets.

[0024]As shown in drawing 4, the optical system of composition of that the semiconductor laser 4 has been arranged at the position P3 which only suitable distance followed to the front from the focus f2 on the optic axis 5a of the concave mirror 5 and this concave mirror 5 may be sufficient as the optical system of the laser-beam-irradiation unit 2. It is [but] good as the semiconductor laser 4 is arranged at the place of the position P4 in which only suitable distance fell back also in this case from the focus f2 which the semiconductor laser 4 has on the optic axis 5a.

[0025]Although the laser beam L is not visible from a direction vertical to a direction of movement, if the smoke S hits the laser beam L as shown in drawing 5, laser beams are scattered about and will be in the state where the dispersion field P can be recognized visually. The dispersion field P comes to look red to the case of a red laser beam. As for a parallel laser beam, since beam strength is uniform, proportionality is realized between the concentration of the smoke S, and the luminosity of the dispersion field P. The smoke perception method which used the scattering phenomenon of the laser beam L by this smoke S for it is applicable regardless of a dark place and a bright place.

[0026]Next, the imaging system b is explained. The imaging system b comprises TV camera (imaging means) 6 installed in the internal-surface side which meets smoke-sensing-area A, and A/D converter 7 which changes the analog video signal of TV camera 6 into a digital video signal, as shown in drawing 2. Of course, as shown in drawing 2, the view of TV camera 6 serves as a form corresponding to smoke-sensing-area A exactly, and the picture of smoke-sensing-area A photoed with TV camera 6 is sent into the signal-processing system c of the next step via A/D converter 7.

[0027]Then, the signal-processing system c is explained. The background image memory (background image memory measure) 8 the signal-processing system c remembers a background image to be as shown in drawing 1, The real image memory (real image memory measure) 9 which memorizes a real image, and the changeover switch SW which switches the digital video signal of A/D converter 7 to the input of the background image memory 8 and the real image memory 9, and is sent into a target, It comprises the image processing portion (image processing means) 10 which performs data processing which deducts a background image from a current image, and the smoke judgment part (smoke judging means) 11 which will output a smoke sensing signal if the existence of the existence of smoke is investigated based on the picture acquired by data processing by the image processing portion 10 and smoke exists.

[0028]As shown in drawing 1 at first (when not having generated smoke, of course), the point of contact SWa and the point of contact SWb of the changeover switch SW are connected, and introductory memory is carried out at the background image memory 8 by using as a background image the picture of smoke-sensing-area A obtained with TV camera 6. Next, after switching to the state where the point of contact SWa and the point of contact SWc of the changeover switch SW connect, introductory memory of the picture of smoke-sensing-area A obtained with TV camera 6 is carried out as a real image at the real image memory 9. Then, the image processing portion 10 performs data processing which deducts a background image from a current image.
[0029]The picture after data processing was made turns into a picture from which only the part which changed from the background image was naturally extracted. Since the background image is the same as a current image and a difference is 0 when there is no generating of smoke, what image will not appear in the picture after data processing substantially, either. Since the dispersion field P of the laser beam L which a current image does not have in a background image appears when smoke has occurred, the difference of both images serves as the dispersion field P, and the dispersion field P will appear in the picture acquired by the image processing portion 10.
[0030]If the smoke judgment part 11 is more than the level which calculates the area of the dispersion field P which appeared in the picture acquired by the image processing portion 10, and the area of the dispersion field P for which it asked makes the standard of a judgment, it will output a smoke sensing signal. Although the method of counting the number of the pixels (pixel of the luminosity more than fixed) in the inside of the dispersion field P as the calculation method of the area of the dispersion field P is illustrated, it cannot be overemphasized that it does not restrict to this method. The signal-processing system c explained here can be constituted focusing on a microcomputer, RAM, or a control program, for example.
[0031]Finally, the operation display system d is explained. The operation display system d comprises the keyboard 12 which performs operation required for operation of the system of working example, the monitor 13 for a display which projects a picture in a color, and the alarm part (alarm generating means) 14 which emits the alarm which teaches perception of smoke.
[0032]In the operation display system d, by operation of the keyboard 12, when carrying out the memory of a background image or the real image, switching control of the required changeover switch SW can be performed, and also selection of the contents of processing in the image processing portion 10 is possible. That is, it can calculate between the above real images and a background image, or a real image is sent out to the monitor 13 for a display as it is, without also performing any operation, and it can enable it to project it. The alarm part (alarm generating means) 14 emits an alarm, when a smoke sensing signal is received from the smoke judgment part 11. A sound, the blink display of a lamp, etc. are raised as a concrete gestalt of an alarm.
[0033]Next, the smoke sensing operation by the smoke sensing system of working example of composition of having stated above is explained concretely, referring to Drawings. First, the point of contact SWa and the point of contact SWb of the changeover switch SW are connected by operation of the keyboard 12, and introductory memory of the picture of smoke-sensing-area A obtained with TV camera 6 is carried out at the background image memory 8. As the picture memorized by the background image memory 8 is shown in drawing 6, although smoke has not come out, it is a background image in which background things, such as the frame 15 and the furniture 16, are appearing.
[0034]Next, smoke sensing operation is started by operation of the keyboard 12. After the point of contact SWa and the point of contact SWc of the changeover switch SW are connected at first, introductory memory of the picture of smoke-sensing-area A obtained with TV camera 6 is carried out at the real image memory 9. Then, data processing by which a background image is deducted from a real image by the image processing portion 10 is performed. The picture acquired by data processing of the image processing portion 10 is sent out also to the smoke judgment part 11 while it is sent out to the monitor 13 for a display. When smoke has not occurred, an image hardly appears in the screen of the monitor 13 for a display, and a smoke sensing signal is not outputted from the smoke judgment part 11. If the processing to one real image finishes, after the real image memory 9 is cleared, it will be repeated that the following real image is [by which introductory memory is carried out] the same as the real image memory 9 again anew.

[0035]And the picture acquired by data processing of the image processing portion 10 when the smoke S occurred and the dispersion field P produced in the laser beam L, as shown in drawing 7 in smoke-sensing-area A, As shown in drawing 8, of course, background things, such as the frame 15 and the furniture 16, disappear, and the picture which only the image of the dispersion field P appeared projects them on the screen of the monitor 13 for a display. On the other hand, in the smoke judgment part 11, as a result of becoming more than a level that the calculation area of the dispersion field P makes a standard and outputting a smoke sensing signal, the alarm which teaches smoke perception from the alarm part 14 is emitted. The generation state and occurrence position of smoke can be grasped from the position and form of the dispersion field P which appeared in the screen of the monitor 13 for a display.
[0036]Then, the smoke sensing system concerning other working example is explained. The system of other working example carries out a turn 90 degrees with the reflectors (mirror) 17-19 which formed the three laser beams L irradiated from the laser-beam-irradiation device 1 in each corner of **, as shown in drawing 9, While setting smoke sensing area as each four wall surface of ** altogether, four sets of TV cameras 6 which photo each smoke sensing area were provided, and also it is a system of the substantially same composition as previous working example.
Explanation is omitted about the composition which is common in previous working example. At drawing 9, although only the one laser beam L is not illustrated, it cannot be overemphasized that the reflector is similarly allocated to other two laser beams L. In the smoke sensing system of other working example, even if it does not increase the number of the laser-beam-irradiation device 1, the smoke perception in a large area is realizable only by forming the reflectors 17-19. Installation of two or more sets of TV cameras 6 also enables it to identify the difference in the character of smoke, such as light smoke and heavy smoke.
[0037]It is not restricted to above-mentioned working example, and this invention can carry out modification implementation as follows, for example.
(1) In the smoke sensing system of working example, although it was the composition of performing signal processing to the picture acquired with TV camera 6, the thing of composition of projecting on the screen of the monitor 13 for a display is also mentioned as a modification, without carrying out signal processing of the picture acquired with TV camera 6 in any way.
[0038](2) The system of this invention allocates in the latter part of the imaging system a the remote transmission system e which comprises the graphical-data-compression transmission part 20 and the picture demodulation section 21, as shown in drawing 10.
On the other hand, the thing of composition of that the monitor for a display of the operation display system d is installed in the transmission destination of a picture is mentioned as a modification.
If it is this modification, remoteness of smoke perception thru/or central control can be performed.
[0039]As are shown in drawing 10 (a) and the remote transmission system e is specifically shown in drawing 10 (b) besides the gestalt allocated between the imaging system a and the signal-processing system c, There are a gestalt which allocated the remote transmission system e between the signal-processing system c and the operation display system d, and a gestalt which allocated the remote transmission system e between the imaging system a and the operation display system d while excluding the signal-processing system c, as shown in drawing 10 (c).
[0040](3) In the system of working example, although the laser beam of the light range was used, the thing using the laser beam (for example, infrared laser beam) of an invisible optical area is mentioned as a modification. In this modification, TV camera 6 needs to make it the thing for invisible lights (for example, infrared type thing). Since a laser beam is not visible to people's eyes at all in case of this modification, there is no possibility that visual sense of incongruity may arise by installation of a system.
[0041](4) Although it was the composition which irradiates smoke sensing area with one laser beam in one laser-beam-irradiation unit in the system of working example, The thing of composition of irradiating smoke sensing area with two or more laser beams in one laser-beam-irradiation unit using beam splitters, such as a half mirror, is raised as a modification.
[0042](5) When the smoke sensing system of this invention and the conventional ionization smoke detector are used together and the conventional ionization smoke detector has detected smoke, the smoke sensing system of this invention may be made to have composition which starts operation automatically.

[0043](6) Although it was the composition whose optical path of a laser beam is fixed, the composition which scans a laser beam using a reflector (mirror) etc. is also raised with the smoke sensing system of working example as a modification. It becomes possible to set up smoke sensing area broadly by the laser beam of a small number after all.
[0044](7) What is necessary is just the smoke which the smoke which the smoke sensing system of this invention makes the object of perception is not restricted to the smoke generated in case of a fire, either, and can make produce light scattering required for a laser beam further.
[0045](8) In a smoke sensing system as shown in drawing 2, if it constitutes so that each [laser beam irradiation unit 2 / itself] may be synchronously made to rock horizontally, wide range space can be supervised by two or more laser beams L.
[0046]
[Effect of the Invention]Since generating of smoke is regarded as a remarkable change of a laser beam according to the smoke sensing system of Claim 1, Since worries about mistake perception disappear and also change of a laser beam comes to project on the screen of the monitor for a display in the form according to the occurrence position and generation state of smoke in smoke sensing area, the generation state of smoke and grasp of a generation place are attained.
[0047]According to the smoke sensing system of Claim 2, since the image which shows only a remarkable change of the laser beam by generating of smoke to the screen of the monitor for a display projects, generating of smoke is recognized visually certainly.
[0048]According to the smoke sensing system of Claim 3, since smoke perception is automatically told in the form of an alarm which is easy to recognize, there is no possibility of overlooking generating of smoke.
[0049]According to the smoke sensing system of Claim 4, far-reaching smoke perception is attained from the ability of smoke sensing area to be set up widely, and the generation state of smoke and grasp of a generation place become still easier.
[0050]Since the laser beam is scanned according to the smoke sensing system of Claim 5, wide range smoke perception can be performed as the laser beam of a small number is also.
[0051]Since a picture projects on the screen of the monitor for a display installed in the place where the picture which shows the situation of smoke sensing area separated from smoke sensing area according to the smoke sensing system of Claim 6, the remote monitor of smoke perception and an intensive monitor are attained.
[0052]According to the smoke sensing system of Claim 7, since the laser beam which runs smoke sensing area is a beam which is not visible to the eyes of those who have the wavelength of an invisible optical area, there is usually no possibility that visual sense of incongruity may arise by installation of a system.

CLAIMS

[Claim(s)]

[Claim 1]A smoke sensing system comprising:
A laser beam irradiation means which irradiates with a laser beam smoke sensing area as an object domain which detects generating of smoke.
An imaging means which photos smoke sensing area.
A monitor for a display which projects a picture photoed by an imaging means.

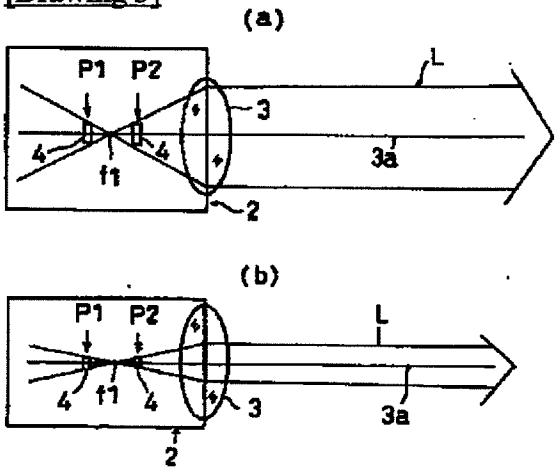
[Claim 2]The smoke sensing system comprising according to claim 1:
A background image memory measure which memorizes a background image of smoke sensing area beforehand photoed by imaging means.
a current image memory measure which memorizes a picture of smoke sensing area which is [every moment] alike by an imaging means, and is photoed as a current image.
An image processing means which performs data processing which deducts a background image from a current image.

[Claim 3]The smoke sensing system comprising according to claim 1 or 2:
A smoke judging means which detects generating of smoke based on a picture of smoke sensing area obtained by an imaging means, and outputs a smoke sensing signal.
An alarm generating means which emits an alarm in response to a smoke sensing signal.

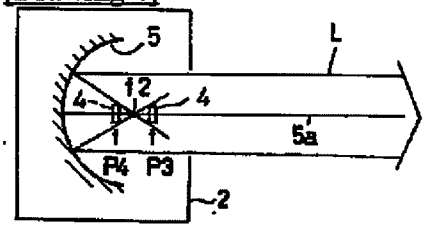
[Claim 4]A smoke sensing system which irradiates smoke sensing area with two or more laser beams which were located in a line almost in parallel as for a laser beam irradiation means in a smoke sensing system given in either from Claim 1 to 3.
[Claim 5]A smoke sensing system with which a laser-beam-irradiation means scans a laser beam, and smoke sensing area is irradiated in a smoke sensing system given in either from Claim 1 to 4.
[Claim 6]A smoke sensing system with which a monitor for a display is installed in a remote transmission destination of a picture while a remote transmission means which performs remote transmission of a picture is allocated in the latter part of an imaging means in a smoke sensing system given in either from Claim 1 to 5.
[Claim 7]A smoke sensing system with which a laser beam which has the wavelength of an invisible optical area is used for either from Claim 1 to 6 as a laser beam in a smoke sensing system of a description.

DRAWINGS

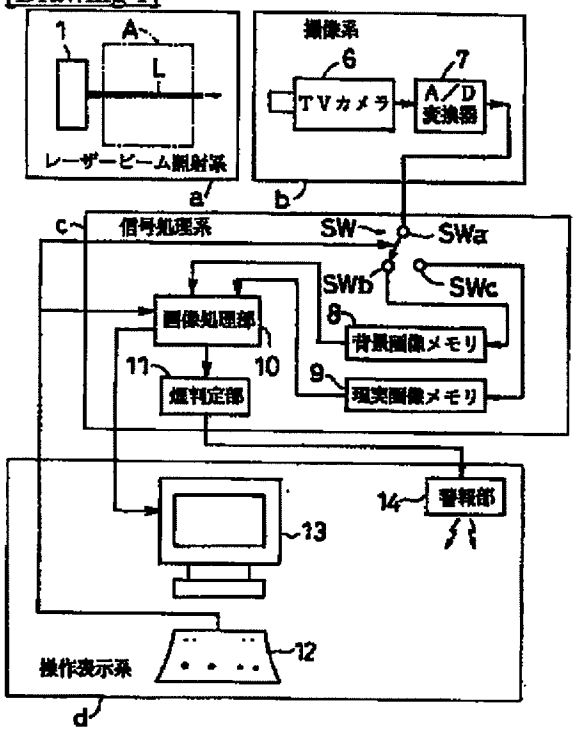
[Drawing 3]



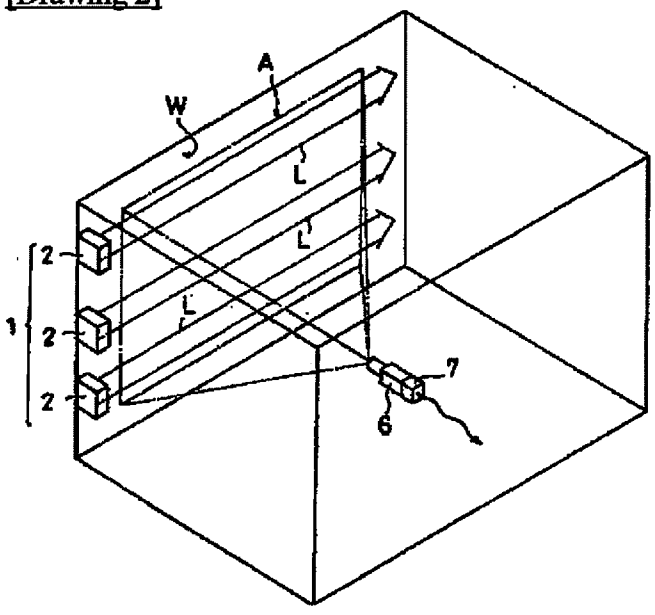
[Drawing 4]



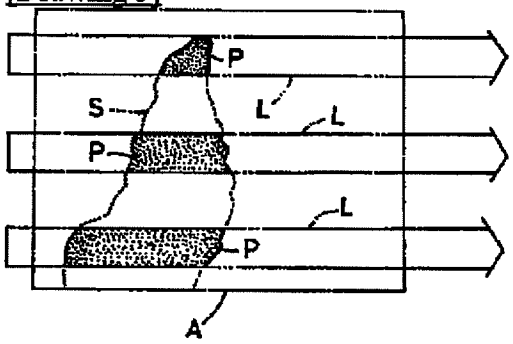
[Drawing 1]



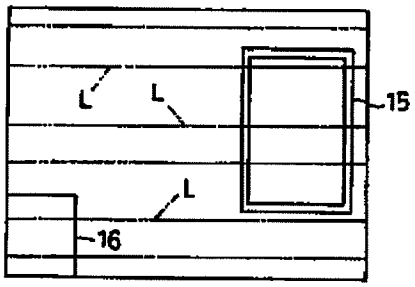
[Drawing 2]



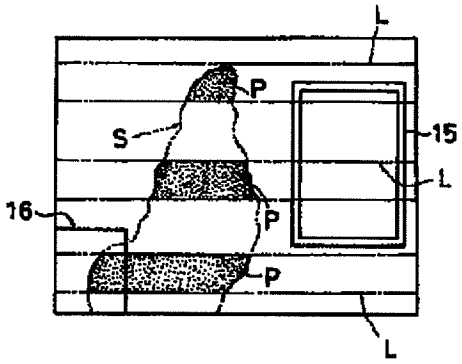
[Drawing 5]



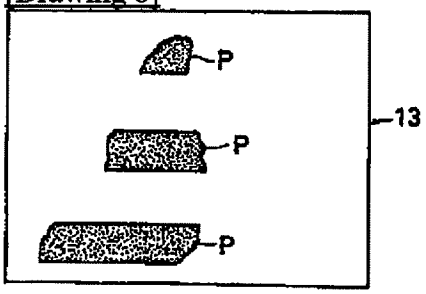
[Drawing 6]



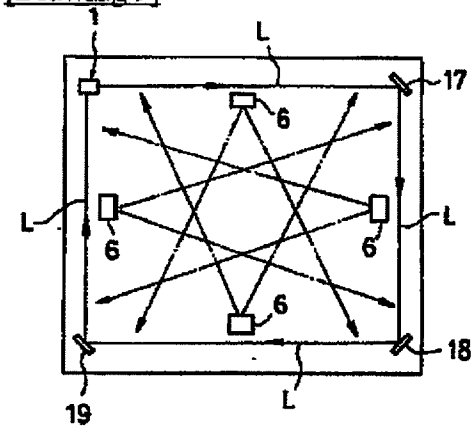
[Drawing 7]



[Drawing 8]

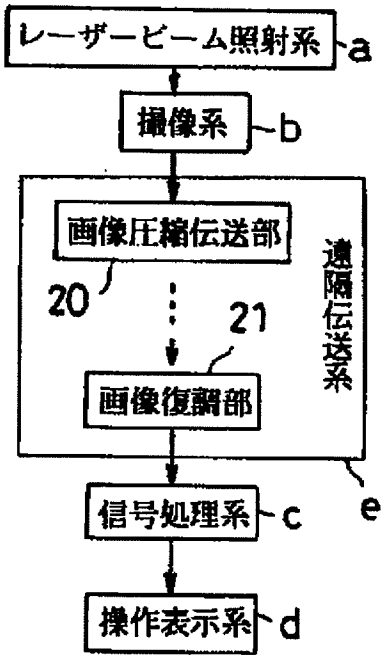


[Drawing 9]

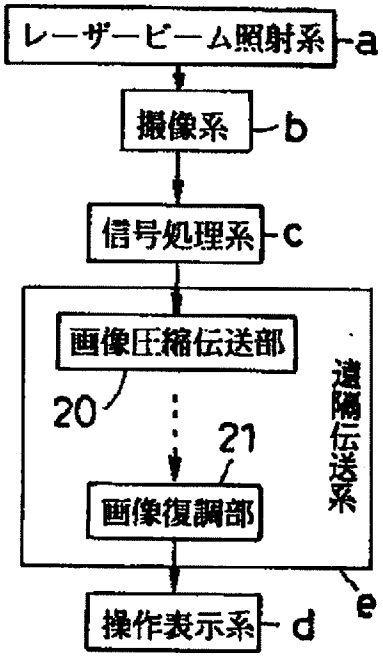


[Drawing 10]

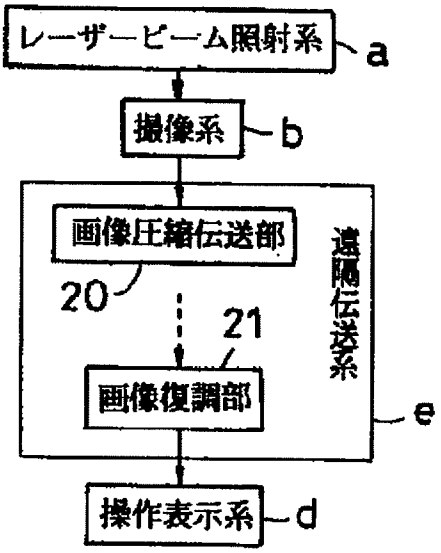
(a)



(b)



(c)



3.In the drawings, any words are not translated.